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Hunger Fighters

The plant breeder is the champion in mankind's first line of defense against hunger. By genetically improving food plants, breeders have forged the Green Revolution, a miracle of plenty in countries of southern Asia so recently poised on the edge of starvation. At home, our classic success story is corn with per acre yields that have quadrupled over those of four decades ago. Despite these considerable achievements, an undercurrent of gloom prevails because the world's population continues to soar, heightening concern over the outcome of the race between the stork and the plow.

What if global population pressures are not curbed? Although experts do not agree on the world's ultimate food-producing capacity, it is clear that some portion of the crops now fed to livestock would have to be diverted to people. In effect, more people would eat lower on the food chain—eat the grain, not the steer, sheep, or hog that ate the grain. It would then become the plant breeder's task to develop even more nutritious varieties of the Big Three—wheat, rice, and corn—to keep pace with humanity's needs for calories and protein. Fortunately, breeders have a working supply of germ plasm with balanced amino acids and protein contents for developing crops rich enough to adequately nourish people. It will soon be possible, for example, to develop corn and oats with protein contents that would be nutritionally adequate for adults and growing children respectively.

Imminent realities, however, should not give rise to complacency. There are inherent risks in dependence on a few elite crops adapted to broad regions because all crops are vulnerable to newly evolved and often devastating diseases. Germ plasm pools are stocked against such emergencies. Time and again plant breeders reach back to the wild ancestors of our domesticated crops to find genes which provide resistance to disease. But man's activities—especially the discarding of primitive crops and the ripping up of land for construction—is taking a serious toll of the richly diverse and often irreplaceable genetic resources still left in nature. These beleaguered resources must be safeguarded while there is yet time. Toward this end, plant explorers and plant breeders are cooperating in establishing a global network of germ plasm conservation centers. They deserve the support of citizens everywhere, for the success of their efforts today will determine how bountiful our market baskets will be tomorrow.

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COVER: *R. nielseni* nematode coiled like a lethal necklace inside the thorax of a Southern house mosquito larva, kills its host as it emerges to molt, mate, and reproduce. See page 3 (BN–38984).

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Mass-produced nematodes

DOWN MOSQUITOES

AN INEXPENSIVE WAY to produce large numbers of tiny roundworms called nematodes offers new possibilities for exploiting the potential of these natural enemies of mosquitoes.

Studies of many nematode species indicate that one, *Reesimermis nielseni*, holds particular promise as a solution to environmental pollution associated with conventional mosquito controls. ARS entomologist James J. Petersen and technician Osborne R. Willis at Lake Charles, La., obtained 100-percent mortality of southern house mosquitoes with *R. nielseni* in laboratory experiments. They released the newly hatched nematodes at a ratio in excess of three per mosquito larva.

Because *R. nielseni* usually kills its host in the larval stage, it has spotty distribution in nature. Other nematode species are transported by the adult mosquitoes they infect to various locations where they emerge and reproduce. However, laboratory studies by Dr. Petersen and his associates indicate that

R. nielseni *nematodes collect at bottom of tank after emerging from the bodies of southern house mosquito larvae. The larvae measure about one-eighth inch long (BN–38951).*

R. nielseni is easy to manipulate and distribute to new areas by man.

In collaboration with nematologist William R. Nickle, Beltsville, Md., Dr. Petersen developed a system for rearing large numbers of this nematode in the laboratory at a cost of only about 10 cents per million infective stage parasites. He uses laboratory colonies of easily reared southern house mosquitoes and stores nematode eggs in moist sand, where they remain viable until needed.

In this system, when nematodes are needed for tests, Dr. Petersen places the nematode egg-sand cultures in tanks of water containing mosquito larvae.

Upon hatching, the nematodes parasitize the mosquitoes, feeding on the hosts' body fluids, thereby debilitating the insects. In the last growth stage of the mosquito larvae, the nematode punctures a hole in its host, killing the mosquito through loss of essential body fluids as the parasite emerges. This process takes only 7 days.

A screen placed parallel to the bottom of the holding tray, about 1 inch above the bottom, permits the postparasitic nematodes to pass through to the bottom of the tray. Mosquitoes are lifted out with the screen, leaving a pure culture of the nematodes, which are then placed on sand in water. Within 2 or 3 weeks after emerging from the mosquitoes, the nematodes molt to adults, which mate. The females lay up to 3,000 eggs apiece. The water temperature can be regulated to hasten or retard the development of the parasites and their hosts.

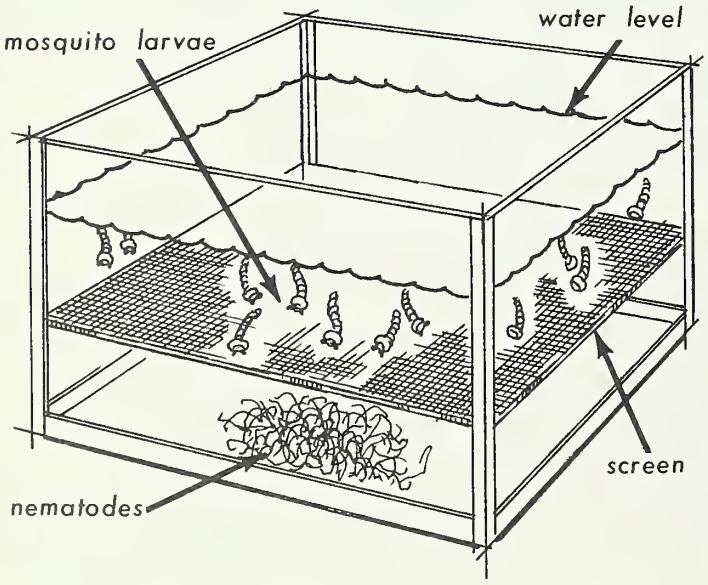
Dr. Petersen and Mr. Willis found that in nature only mosquitoes were infected by *R. nielseni,* and a 2-year survey showed that this nematode infects 13 of 19 mosquito species inhabiting selected areas of Louisiana. *R. nielseni* is able to survive only on insects, and therefore does not represent a threat to plants.

Although ARS entomologist Donald B. Woodard exposed many nontarget aquatic organisms to the nematode in the laboratory, only several close relatives of mosquitoes (chaoborids) were attacked.

As with all control measures, the nematodes also have certain limitations. In addition to cold weather, which inactivates the nematodes, polluted or salt water kills too many to provide adequate control of mosquitoes—some species of which are tolerant to a considerable degree of pollution or salt water.

In unpolluted water, the nematodes have provided good mosquito control when distributed in selected areas of Louisiana, Maryland, and California. The parasites appeared effective in reducing mosquito populations breeding in permanent bodies of water as well as in sites that dry up periodically.

McNeese State University, Lake Charles, La., is cooperating in the ARS studies. The U.S. Public Health Service is cooperating in additional field tests with *R. nielseni* in El Salvador. The United Nations' World Health Organization is also testing the nematode in Taiwan and Thailand. □



Above: *Mass-rearing tank—an aquarium separated into two parts by a screen which keeps mosquito larvae above while postparasitic nematodes drop below (PN–2015).*
Right: *Nematodes penetrated mosquito larvae after hatching and are growing on the hosts' body fluids (BN–38952).*

Natural shield against greenbugs

THE historic relationship between alcohol and barley may be predated by an even older relationship—a natural alcohol constituent in barley protects them from a species of aphid called the greenbug.

Greenbugs evidently do not like the benzyl alcohol content in resistant barley, such as Omugi. When scientists artificially infested barley seedlings with 120 greenbugs, the insects only slightly damaged Omugi barley but destroyed the Rogers variety. Laboratory analyses established that Rogers barley has virtually no benzyl alcohol in the plant tissue, in marked contrast to Omugi barley. ARS entomologists Robert L. Burton and Kenneth J. Starks and biochemists Prem S. Juneja and Robert K. Gholson of the Oklahoma Agricultural Experiment Station, Stillwater, conducted the studies.

Along with differences in damage, the scientists found differences in the pest's reproduction on the two varieties. After 4 days, about 18 offspring per adult greenbug appeared on susceptible barley. In contrast, the scientists found only about eight offspring per adult on resistant barley.

In related experiments the scientists showed that susceptible barley can be made resistant when benzyl alcohol is added to plant nutrients. They rooted susceptible seedlings in water and added benzyl alcohol to the water at a rate of 100 parts per million (ppm). Later analyses revealed benzyl alcohol in stem and leaf tissue.

Separate experiments indicated that the addition of alcohol at a rate of only 1 ppm was as effective as larger amounts. Applications of 1,000 ppm had slightly toxic effects on the plants.

The treatments also reduced greenbug reproduction on susceptible barley to the same level as observed on untreated resistant barley: About eight offspring per adult. However, addition of the alcohol to resistant plants did not further increase their resistance.

Similar results occurred in tests with Wheatland sorghum, a susceptible variety, and IS 809, which is resistant. The sorghum received a 0.1 percent solution of benzyl alcohol in about 1 gallon of water over a 3-week period.

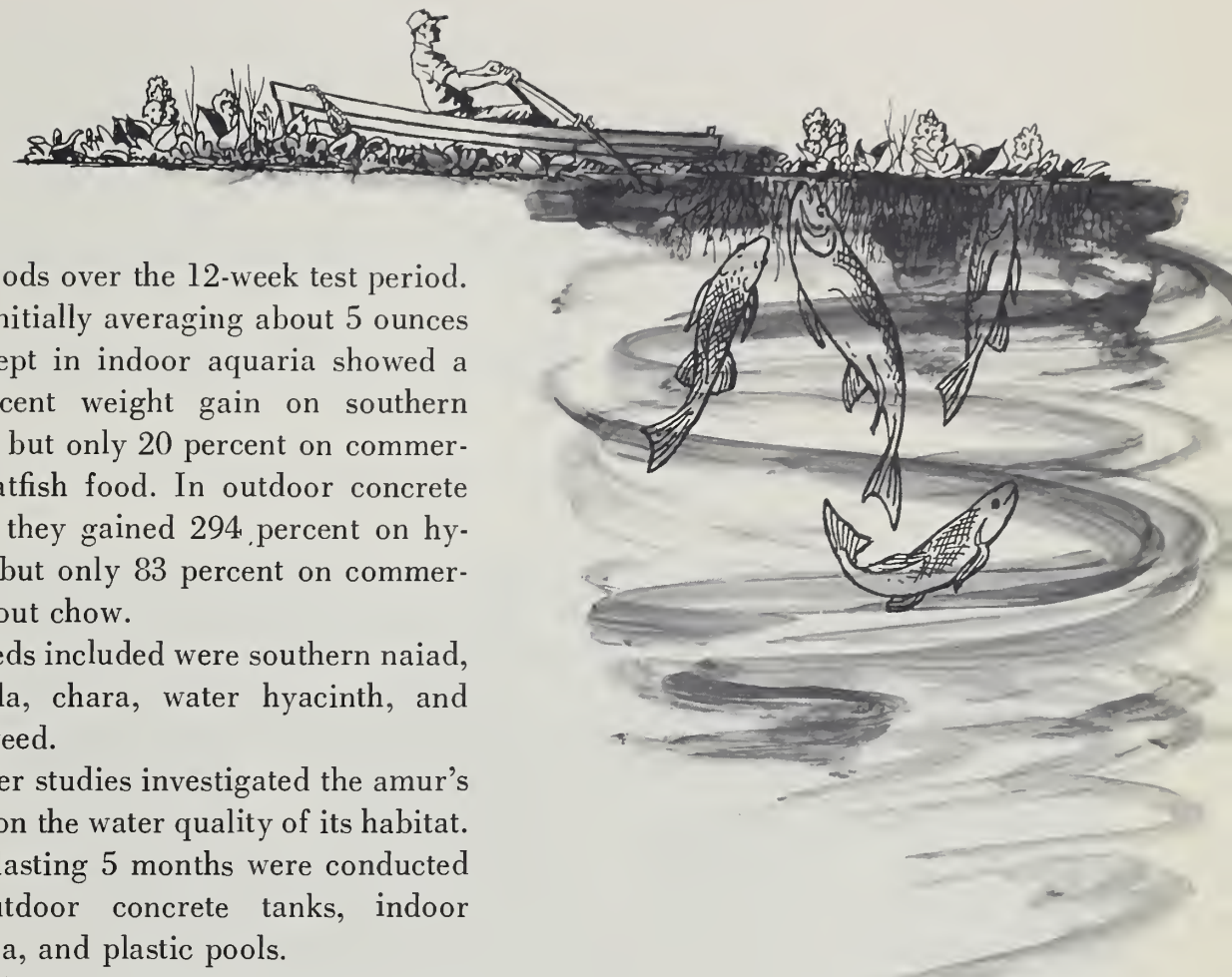
Use of benzyl alcohol to control greenbugs may have advantages over conventional insecticides. The compound is active in low concentrations, and preliminary evidence indicates it affects only the target insects. Because benzyl alcohol is a naturally-occurring compound in barley and sorghum at low concentrations, it would be expected to be nontoxic to higher animals and readily biodegradable.

Barley and sorghum are the second and third crops found resistant to insects on the basis of a specific natural ingredient of the plants. Earlier, ARS entomologists in cooperation with the Iowa Agriculture and Home Economics Experiment Station, Ames, identified a plant constituent responsible for corn's resistance to European corn borers (AGR. RES., Feb. 1969, p. 6). □

fish that weed

This young white amur, weighing about 2 pounds, was caught with spinning tackle. With an average weight gain of around 3½ to 5 pounds a year, adult amurs average 50 to 60 pounds. Top weight is 80 pounds. Studies indicate that this species will not spawn in our waters unless artificially injected with hormones. This could provide a check against exploding populations (PN–2016).

the water...



FISH STORIES usually end with some version of "The one that got away." For a change, here's one that could lead to something considerably more positive—biological control of aquatic weeds.

The one that didn't get away in this case is a voracious vegetarian called the white amur, a fish of the carp family that is native to China, Manchuria, and Siberia. It is used in the Soviet Union, Poland, Czechoslovakia, India, and China for both weed control and food.

"This fish, with its insatiable appetite for aquatic vegetation, may develop into one of our most effective biological control agents" predicts ARS botanist Robert D. Blackburn. Weeds choke off waterways, play hob with recreational activities, and cause loss of irrigation water through transpiration—giving off moisture from leaf surfaces.

The white amur also looks promising as a source of dietary protein and as a challenging sporting fish. Moreover, unlike most other herbivorous fish, it can tolerate wide temperature extremes, making it adaptable to many parts of the United States. Under ideal conditions, it can gain a half pound a month and reach a top weight of over 60 pounds.

Diets, stocking rates, and the effects of the amur on aquatic environment are under study by Mr. Blackburn in cooperation with the Florida Agricultural Experiment Stations, Fort Lauderdale, and the Florida Department of Natural Resources.

In the diet studies, the amur gained well on submerged weeds and, in fact, did better on weeds than on commercial fish foods over the 12-week test period. Fish initially averaging about 5 ounces and kept in indoor aquaria showed a 60-percent weight gain on southern naiad, but only 20 percent on commercial catfish food. In outdoor concrete tanks, they gained 294 percent on hydrilla but only 83 percent on commercial trout chow.

Weeds included were southern naiad, hydrilla, chara, water hyacinth, and duckweed.

Other studies investigated the amur's effect on the water quality of its habitat. Tests lasting 5 months were conducted in outdoor concrete tanks, indoor aquaria, and plastic pools.

Stocking rates were equivalent to 380, 2,300 and 2,000 fish per surface acre of pond. Water was tested for hardness, acidity, cloudiness, alkalinity, and other variables that determine water's ability to support life.

Compared to control tanks with no fish, the greater the fish density, the greater the detrimental effects caused by the fish. In all tests, stocking rates were higher than they would be in practice. Mr. Blackburn suggests that although these tests are not conclusive, the amur probably would not adversely affect water quality with lower stocking rates under field conditions.

In future studies, small earthern ponds in Florida will be stocked with amur. Mr. Blackburn figures that a stocking rate of 20 fish per surface acre of pond, using fish 6 inches long or longer, will control aquatic plant growth. Research will also be directed at finding the amur's effect on fish and other aquatic life in the environment.□

Tracing feed additives in the environment

ALTHOUGH researchers have studied in depth the effect of feed additives on cattle, only limited knowledge is available of their overall movement in the environment.

ARS scientists are working to fill this gap through a two-phase study which will examine the effects of additives on cattle utilization of all-roughage diets and the fate of these additives when they leave the animal's body in waste products.

ARS physiologist Theron S. Rumsey and ARS nutritionists Robert R. Oltjen and David A. Dinius are testing three common additives—diethylstilbestrol, a growth-promoting hormone; chlorotetracycline, an antibiotic to prevent liver abscesses; and an organic phosphate, a systemic insecticide to internally kill cattle grubs.

The first phase now in progress at Beltsville, Md., involves all-roughage diets alone and in combination with the additives. Such diets for cattle may be common in the future when cattle will be competing more intensely with man for direct protein and energy needs from grains.

Diet 1 is composed of 98½ percent pelleted alfalfa hay, one-half percent sodium phosphate, and 1 percent trace mineral salt. In diet 2, clover hay is substituted for the alfalfa. In diets 3 and 4, 10 percent of the hay in diets 1 and 2 is replaced with cane molasses. Diets 5, 6, 7, and 8 repeat the diets above except that they all contain standard recommended amounts of each of the feed additives.

After 168 days on these diets, the cattle will be slaughtered and extensive carcass evaluations made to determine if additives have accumulated in various parts of the carcass. Results of the animal performance tests will provide further information on finishing beef cattle on all-roughage rations.

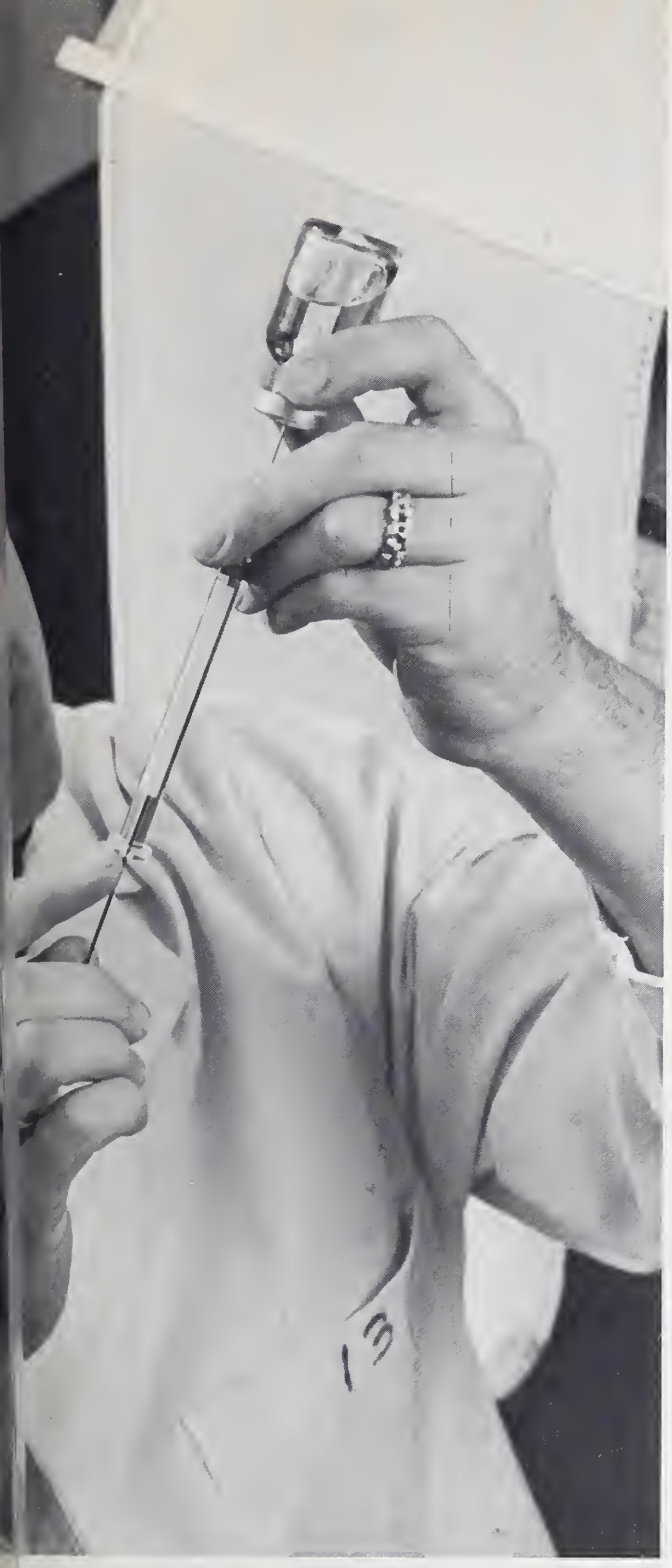
The second phase of this experiment is to determine how much active chemical from the additives is present in the voided feces, how composting and bacterial action affect the additives, and after these wastes are spread on pasture, how the additives move through the soil profile and forage to possibly accumulate in grazing animals.

All wastes are being collected in drainage areas around the feedlots, and the scientists are analyzing the manure and runoff for chemical residues. ARS nutritionist Richard W. Miller is covering the manure pits to study the effects of various systems of fly control on the fly populations in the manure. Large amounts of manure in feedlots pose a continual problem in fly control.

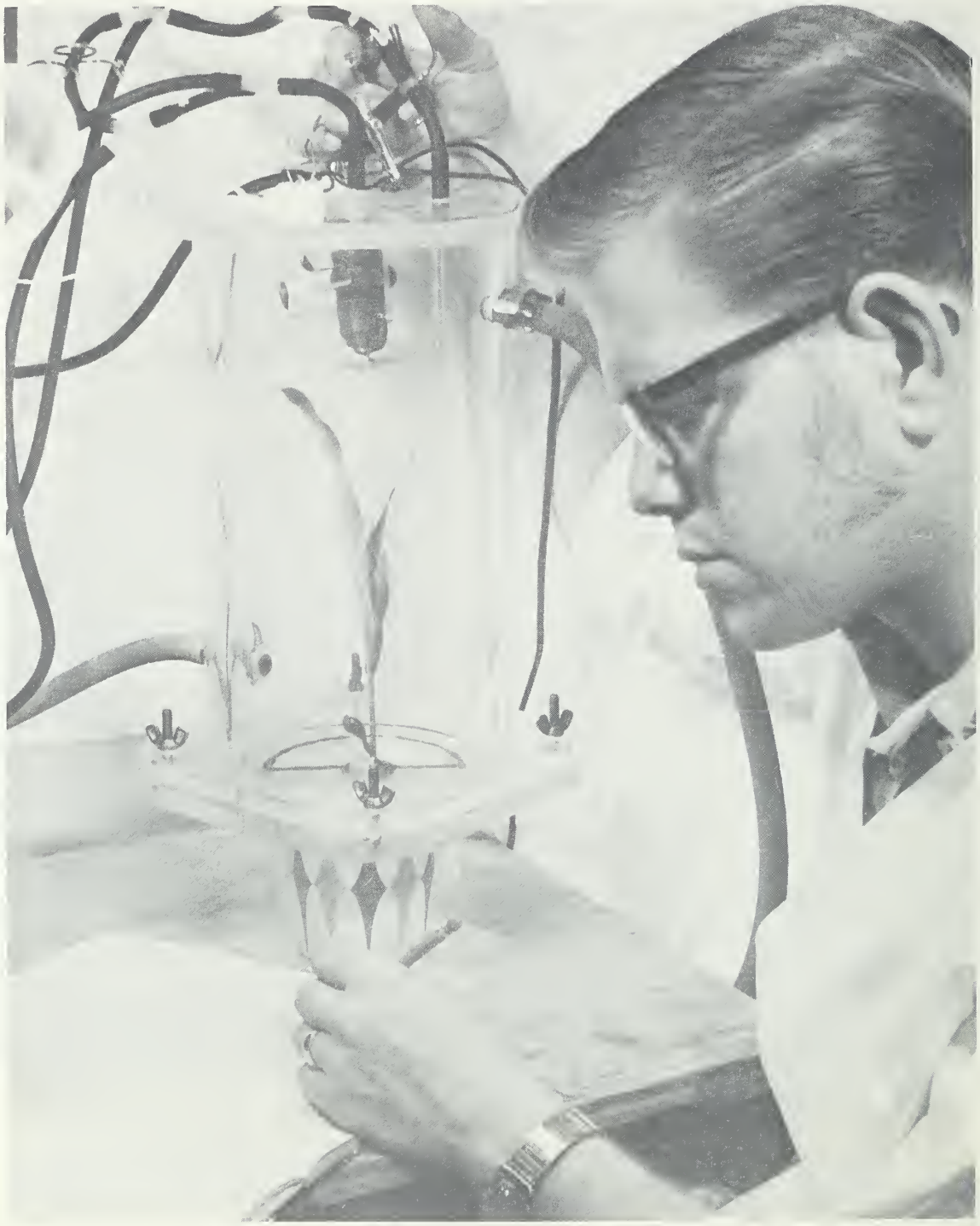
The manure from each feedlot will be spread on separate pastures at the rate of 10 tons of dry matter per acre. Other plots will include a control as well as one plot spread with dairy and one with poultry manure. These plots will give comparisons between residue problems of dairy and poultry operations with those of beef feedlots.

In the spring, sheep will graze the plots and undergo biopsies at intervals to determine if the chemicals from the manure have been taken up in the grass and are accumulating in the animals. Sections of each plot will be fenced off so chemical evaluations can be made on the forage.

The study is being conducted to resemble as closely as possible standard commercial feedlot operations. Information from this experiment will better enable scientists and livestock producers to evaluate the benefits and drawbacks of using feed additives. □



Top left: *ARS biologist Adrian S. Kozak prepares a sample of fecal material voided by treated cattle. The sample will undergo gas chromatographic analysis to determine the amount of diethylstilbestrol it contains (1271A1597–15).*
Bottom left: *Dr. Rumsey adds precise quantities of additives to the daily ration of test animals. In the far background, manure is scraped into collection pits for later distribution on pastures (1271A1603–23).*
Below top: *Dr. Oltjen and Dr. Rumsey observe as collection pits are emptied into a manure spreader. Pits are emptied at 3-month intervals (1271A1604–19).*
Below bottom: *Worker spreads manure from each feedlot onto selected pasture land. Sheep grazing the land will undergo biopsies to determine if additives are accumulating in the animals (1271A1604–5).*



Mr. Hutchinson monitors flow of air-ammonia mixture into and out of two-chamber device via hoses at top. Hoses at side circulate water between double walls for temperature control. Paper cup below is sealed off from upper chamber (PN–2017).

Leaf pores... pollution fighters?

PLANT LEAVES act as a "sink" or natural filter that passes atmosphere ammonia. Leaves absorb the ammonia through their stomata—leaf pores—and satisfy some of their nitrogen hunger via that route.

This knowledge could be important to agronomists concerned with the production of food and fiber and to environmentalists anxious about air and water pollution.

Recent studies by ARS soil scientists Gordon L. Hutchinson, Ft. Collins, Colo., and Richard J. Millington and Doyle B. Peters, Urbana, Ill., showed that a field crop growing in air containing ammonia at normal atmospheric levels may satisfy as much as 10 to 20 percent of its total nitrogen requirement by direct absorption of ammonia from the air.

Although it was previously accepted that plants used small amounts of atmospheric ammonia through the mechanism of soil absorption followed by root uptake, only recently has direct gaseous ammonia exchange between plant leaves and the air been seriously considered.

Atmospheric ammonia's role in the over-all nitrogen cycle has had little attention in the past, probably because of the extremely small concentration of ammonia "normally" found in the air.

Scientists, mindful of the ever-increasing sources of atmospheric ammonia—combustion of coal, auto exhaust, animal feedlots, fertilizers, municipal sewage facilities, and the

chemical industry—are taking a close look at the interactions between atmospheric ammonia and the soil-plant-water system.

The ARS studies were drawn up to make certain that ammonia was indeed being absorbed and metabolized by the plants and that the route of entry was through the leaves.

The scientists designed a two-chamber device that sealed off plant roots and soil from the tops of plants while isolating both from the external air. They also controlled the air circulation and temperature of the upper chamber. There was no air mixing or exchange in the soil, or lower chamber.

Disappearance of ammonia was followed by analyzing a gas stream flowing through the upper chamber after a 6-inch soybean plant had been placed in the device.

Results showed that the ammonia absorption rate was fairly constant the first day, but dropped sharply at "night," apparently reflecting the closing of the stomata. After the lights were turned on the following morning, the ammonia absorption rate climbed rapidly, and after 2 hours reached a plateau slightly higher than the previous day's high—partially attributable to the growth of the leaves overnight.

The total amount of ammonia absorbed by the soybean plant during the 24-hour period—about 70 micrograms—was nearly enough to saturate the water contained in the plant. Since there was no hint of ammonia saturation and strong dependence of the uptake rate on stomatal opening, the conclusion was that the ammonia was being metabolized and not simply adsorbed onto exterior leaf surfaces or dissolved in the water surrounding leaf mesophyll cells.

Plants apparently retain their capacity for absorbing ammonia even when well supplied with nitrogen.

There were some differences in ammonia absorption rates among species. Cotton absorbed the least ammonia, followed in increasing order by soybean, sunflower, and corn. □

Beetles that protect cattle

THE lowly dung beetle can help free cattle from parasitic worms by burying manure pads containing parasite eggs. The parasites are thus prevented from hatching and crawling onto the surrounding grass where they would be eaten by grazing cattle.

The medium stomach worm (*Ostertagia ostertagi*) severely damages the stomach lining of its host by boring into the lining. Infected cattle may scour, be weak and stunted, and show signs of anemia. Severe infections cause death.

ARS zoologist G. Truman Fincher, Tifton, Ga., is studying the dung beetle, which buries infected manure pads as food for its young.

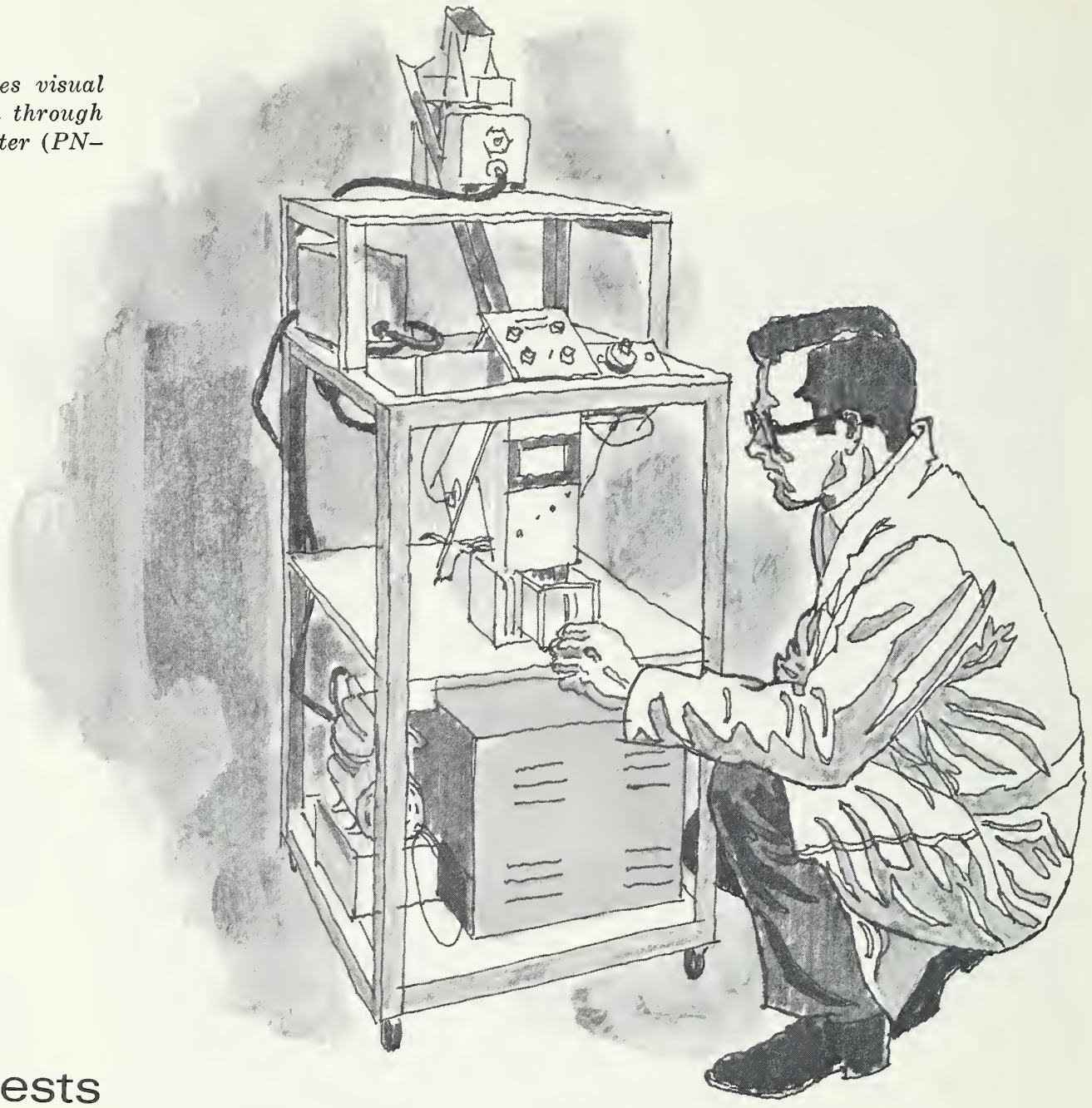
He placed manure pads containing parasite eggs in three pasture plots. Two plots were enclosed in screen wire and the third only had a screen wire top. Captured beetles were placed in plot 1, no beetles were permitted in plot 2, and the native beetle population had free access to plot 3.

Two manure pads were deposited in each plot every other day until there were 20 pads per plot. Once a week for 10 weeks, the scientist recovered and counted parasite larvae from the plots.

Captured beetles buried all pads in plot 1 within 24 hours after deposition. Native beetles buried few pads in plot 3. None of the pads in plot 2 were buried.

As a result, the scientist recovered 14.7 times more parasite larvae from plot 2 and 3.5 times more larvae from plot 3 than were recovered from plot 1.

Increased beetle populations could, therefore, serve a useful purpose in biological control of parasites. In several areas of the world, beetles exist which would aid, not compete with, our native species. Introducing beetles adapted to our climate and soils would probably be the best means of increasing our beetle populations. □



Milled rice undergoes visual inspection after run through the experimental sorter (PN–2018).

twin tests for RICE SORTING

SORTING RICE on the basis of both light reflectance and light transmittance of sample kernels results in fast, accurate, and objective grading.

A conventional color sorter provides the light reflectance readings. A newly developed electro-optical device can measure the differences in transmittance of individual kernels. Interfacing the two permits removal of more than 75 percent of the total damaged kernels.

To insure the American consumer of quality food, more than 50,000 samples representing over 3 million tons of milled rice are visually inspected each year for heat-damaged kernels, objectionable seeds, red rice, chalky kernels, and other forms of damage. A critical need exists, however, for instrumentation and mechanical devices to reduce inspection cost and to provide more uniform, accurate grading by eliminating errors in human judgment.

Normal milled rice kernels are glasslike and highly translucent, but these properties are impaired to some degree in most abnormal kernels. ARS agricultural engineers Kenneth R. Beerwinkle and Raymond A. Stermer, College Station, Tex., explored the possibility of using this fact to sort rice optically on the basis of transmittance differences. The idea was to add this feature to conventional reflectance-type color sorters.

Color sorters already aid in removing certain forms of damaged kernels. The equipment consists of an illuminated product-viewing area where a group of photosensors is trained on a background reflecting a light of known color and intensity. This light is desig-

nated as the grading standard. Any product reflecting light of a different color or intensity from that of the background as it passes in front of the photosensors triggers a rejection system.

With color sorting, however, efficiency is sacrificed with high flow rates, and chalky kernels and certain other forms of abnormal kernels are difficult to separate. By complementing the color sorter with a device that first measures a kernel's translucence by directing a beam of restricted light or radiation through a kernel, then compares the results to the transmission properties of normal and abnormal kernels, the ARS researchers are able to overcome this handicap.

The resulting modified module can sort on the basis of either reflectance differences or transmittance differences, or on both simultaneously. When operating at feed rates of up to 50 grams per minute, reflectance sorting removes less than one-fourth of the damaged kernels; combined sorting increases this efficiency by 50 to 75 percent. The combined sorter is experimental and not commercially available. □

Hormones that kill TOBACCO BUDWORMS

SEVERAL COMPOUNDS that interrupt insect development may prove effective as insecticides or chemosterilants in controlling the tobacco budworm, a major threat to cotton in the Gulf States.

The experimental compounds were among 26 tested for juvenile hormone activity by ARS entomologists Antonio A. Guerra, Dan A. Wolfenbarger, and Maurice J. Lukefahr in Brownsville, Tex. Some of the compounds were most effective when applied directly to the skin of budworms; some were more effective as foliar sprays; and one worked best when incorporated in the larval diet.

In the direct application tests (simulating field spraying), five compounds either completely inhibited or dramatically reduced adult budworm emergence when the larvae were treated. Affected larvae also failed to shed their skins during larval to pupal molting. Four of the five compounds and three additional ones had similar effects on adult emergence when pupae were treated.

Treating adults with one compound reduced egg hatch as much as 93 percent. Three compounds completely inhibited egg hatch when larvae were treated.

Of the 15 compounds tested as foliar sprays on cotton leaves, 12 significantly restricted larval or pupal development; 13 significantly affected the egg laying of adults when they were treated as larvae; and all 15 affected the number of eggs that hatched. One of the compounds reduced egg hatch 99.6 percent when the male adult was treated, and 100 percent when the female was treated. Both show promise as chemosterilants.

The compound found effective in laboratory-prepared larval diets killed more than 60 percent of the larvae in 7 days. Pupation and adult emergence of the survivors was reduced by nearly 100 percent. When the same diets were fed to larvae 4 and 8 days old, the proboscis was reduced in length 95 percent or more. The diets tested contained 0.01 and .10 percent of the compound and were fed to 1-, 2-, and 3-day-old larvae.

Hormones and like compounds have also shown promise against Mexican bean beetles (AGR. RES., May 1970, p. 15), cockroaches and yellow mealworms (AGR. RES., Mar. 1966, p. 8; Aug. 1969, p. 16), tobacco hornworms, house flies, confused flour beetles, yellow fever mosquitoes, and German cockroaches (AGR. RES., Dec. 1968, p. 5). □

Rene Dubos named Morrison Lecturer

Dr. Dubos (BN–38900).

DR. RENE JULES DUBOS, eminent microbiologist and Professor Emeritus of Rockefeller University, will give the fifth annual B. Y. Morrison Memorial Lecture in Stockholm, Sweden, in June.

ARS will present this year's Morrison lectureship in cooperation with the Scientists' Institute for Public Information at an Environmental Forum to be held concurrently with the first United Nations Conference on the Human Environment. The Forum is under the auspices of the U.N. Association of Sweden and the National Council of Swedish Youth. ARS established the Morrison Lecture in honor of Benjamin Y. Morrison (1891–1966), the first director of USDA's National Arboretum in Washington, D.C.

Both a medical microbiologist and an experimental pathologist, Dr. Dubos first demonstrated the feasibility of obtaining disease germ killers from microbes. Over 40 years ago he isolated a soil microbe enzyme that could destroy the protective capsule of pneumococcus, the organism responsible for lobar pneumonia. In 1939, he discovered tyrothricin, an antibiotic produced by growth of *Bacillus brevis* and precursor of the antibiotics gramacidin and tyrocidine. His revolutionary work led to the practical use of such drugs as penicillin and streptomycin.

In recent years Dr. Dubos has become concerned with the effects that environmental forces—physiochemical, biological, and social—exert on human life.

Born in Saint Brice, France, Dr. Dubos came here to study bacteriology in 1924, earning his Ph. D. from Rutgers University in 1927. Until he retired in 1971, he was a faculty member of Rockefeller University, except for two years when he held professorships at the Harvard University Medical school.

Dr. Dubos is the author of more than a dozen works including *The Bacterial Cell, Man Adapting,* and its Pulitzer Prize-winning sequel, *So Human an Animal* (1968). His latest book, *A God Within,* is scheduled for publication in August.

Morrison lecturers are nominated by representatives of national and international scientific organizations concerned for the earth environment. □

Keeping cottons flame-resistant

SOME fire-resistant cotton garments can lose their effectiveness when laundered at home with detergents in areas of moderately hard or hard water.

Research indicates, however, that the problem can be easily corrected by rinsing the cottons in a mild acid solution during laundering. This is most easily done by adding about 8 ounces of white vinegar to the rinse cycle of household washing machines. If preferred, the cottons can be sent to a commercial laundry where a mild acid rinse is part of the standard laundering procedure.

Chemists Ralph J. Brysson and Biaggio Piccolo and technician Albert M. Walker found that calcium in hard water reacts with phosphorus or phosphate in detergents to create calcium and magnesium phosphates which are deposited on cotton fibers. The same type of coating action results when phosphate-free detergents are used, and calcium and magnesium salts are deposited.

The findings were made at the ARS Southern marketing and nutrition research laboratory, New Orleans, La. All of the flame-retardant finishes tested, both laboratory and commercial finishes, were based wholly or in part on phosphorus-containing compounds. Fabrics were sent through 50 wash-dry cycles, and durability and effectiveness of the finishes were checked by testing at intervals for flame retardancy and phosphorus retention. □

AGRISEARCH NOTES

Poultry floor space by sex

Too much or too little floor space per bird can cost the broiler producer money, but new mathematical formulas can now save those dollars.

Producers know that the amount of floor space allotted to each broiler is important in getting the best gain in the least amount of space. However, many use the same stocking rate per bird when the sexes are raised separately as when they are raised together. This can result in a disadvantage to males that may be crowded and an advantage of females who have more floor space than they can efficiently utilize.

To correct this situation, ARS scientists James W. Deaton, Floyd N. Reece, Leon F. Kubena, and James D. May, State College, Miss., devised two formulas to equalize the space given to each bird according to sex. These formulas were proven valid in trials with commercial broilers.

The new formulas make use of the standard stocking rates for male and female birds combined (R_C) and the ratio of the body weight of the females as a fraction of the male body weight (F/M). Body weight is based on the weight of the broilers at 8 weeks of age. The formulas are:

$$\text{Male stocking rate} = \frac{2}{F/M+1} \times R_C$$

$$\text{Female stocking rate} = \frac{F/M}{\left(\frac{F/M+1}{2}\right)} \times R_C$$

In two trials, the scientists separated 1,488 broilers by sex and raised them at stocking rates computed by the new formulas. In one trial, the combined stocking rate used was 0.8 square foot per bird and rates for males reared separately were computed at 0.87 sq. ft. per bird and for females, at 0.73 sq. ft. per bird. In the other, the combined stocking rate was 0.55 sq. ft. per bird, and the formula gave males 0.6 sq. ft. and females, 0.5 sq. ft.

In both trials, the difference between male and female body weight per sq. ft. of floor space was 0.03 pounds. This compares to 0.9 pounds when broilers were raised separately by sex, but the common combined stocking rate of 0.8 sq. ft. per bird was used for both sexes.

Alcoholic citrus means bad storage

Too much alcohol in citrus fruit, as in humans, may be disastrous.

ARS chemist Paul L. Davis, Orlando, Fla., found that a sharp increase of alcohol (ethanol) content in the juice during fruit growth may be a measure of maturity. However, when the alcohol content in harvested fruit rises far above that at maturity, it indicates adverse storage conditions. Off-flavor in the fruit often follows. Mr. Davis made these findings in studies of citrus over two seasons.

At present, evaluations of stored citrus are based on its taste or rind condition—both subjective indications. An inexpensive, objective test has been badly needed by the citrus industry.

To measure the alcohol content of the juice, Mr. Davis devised a simple and quick method that may provide such a test. Ten milliliters of juice in a stoppered container are held at a constant temperature of 36° C. for one hour. During this time the volatile alcohol equilibrates between the juice and the air above the juice (called headspace). Thus, the amount of alcohol in the headspace is proportional to the concentration in juice. A portion of the alcohol in the headspace is removed by a syringe and run through a gas chromatograph. Readings are obtained in 1 minute.

If the results show two to three times the normal alcohol concentration, then storage conditions are not satisfactory and should be revised to maintain the alcohol content near that of the fruit at harvest.

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Charcoal reduces pesticide residues

Adding activated charcoal to livestock rations after discontinuing treatment with ronnel insecticide further insures against pesticide residues in the meat at slaughter.

Ronnel is registered by the Federal Government for systemic control of grubs in beef cattle, but it must be withdrawn from the feed at least 60 days before slaughter to permit elimination of potentially hazardous residues from the meat. Ronnel is not registered for use on dairy cattle.

In studies by ARS veterinarian Harry E. Smalley, College Station, Tex., activated charcoal fed to sheep significantly reduced the level of ronnel in the omental fat, the site where pesticides persist. Dr. Smalley substituted sheep for cattle in his studies because of the high cost of using cattle.

He employed six groups of three ewes and three wethers each. All groups were fed the same basic ration but groups 1, 2, and 3 also received 1,000 parts per million ronnel. In addition, group 2 was given 5-percent activated charcoal, and group 3, a twice weekly drenching of a charcoal slurry. The other three groups did not receive the ronnel but group 5 did receive the 5-percent activated charcoal and group 6, the charcoal slurry. The sheep were fed for 84 days, about the length of time lambs would be in a feedlot, plus an additional 21-day period for excretion of residues.

Feeding activated charcoal reduced residues in the omental fat to 10 percent of those in sheep not receiving the charcoal. Drenching with the charcoal slurry, however, was ineffective.

Nematocide benefits sweet potatoes

Tests shows that a nonfumigant nematocide can increase yields of high-quality sweet potatoes.

The nematocide, *O*,-ethyl *S*,*S*-dipropyl phosphorodithioate, underwent five seasons of testing by ARS nematologist Wray Birchfield. Plant pathologist, Weston J. Martin, Louisiana Agricultural Experiment Station, Baton Rouge, La., cooperated in the research.

The nematodes involved, root knot and reniform types, produce spots in the potato and yellowing of foliage, reducing yield and grade.

Greatest nematode kill and yield increase of U.S. No. 1 grade sweet potatoes were obtained with 3 pounds active ingredient per acre formulated as 10-percent granules in a 15-inch band covered by bedding in the open row.

In treated fields infested with root knot nematode, yields of U.S. No. 1 potatoes increased an average of 53 bushels per acre (45 percent) over yields from untreated fields.

Reniform nematode control was equally successful. Average increases in U.S. No. 1 grades of 58 bushels per acre (63 percent) followed the treatment.

The nematocide is registered for use on sweet potatoes as a preplant application of 3 pounds active ingredient per acre 2 weeks before planting. The chemical kills nematodes by contact, and no known residues accumulate in the sweet potato.

Before a pesticide can be registered and released to the public, it must undergo stringent tests by its manufacturer, who then submits the tests data to the Federal Government for evaluation and registration.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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